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Analysis of the Business Cycle and Capital Structure Relation in the US
Analýza vztahu obchodního cyklu a kapitálové struktury ve Spojených státech

Student: Bc. Nan Wang

Supervisor of the diploma (bachelor) thesis: prof. Ing. Tomáš Tichý

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1. Introduction
2. Prior Research Review
3. Sample Description and Methodology
4. Results and Discussion
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Bibliography
List of Abbreviations
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Ing. Iveta Ratmanová, Ph.D.
Head of Department

prof. Dr. Ing. Zdeněk Zmeškal
Dean

The declaration

"Herewith I declare that I elaborated the entire thesis, including all annexes, independently"

Ostrava dated 19.04.2019

Nan Wang

Student's name and surname

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1 Introduction

Capital structure is closely related to corporate operation, governance, development and future planning. Since late 20^{th} century, a large number of studies have proposed a series of capital structure theory, forming a system to explain the theory of capital structure from multiple angles. Meanwhile, a large number of empirical analysis of the factors affecting capital structure decisions provide evidence for these theories.

At very beginning, the researches only focused on determinants at the company-level. From microeconomic point of view, investigators found that firm-specific factors such as firm size, profitability, growth and other variables may affect the company's choice of capital structure.

In recent years, more and more studies pay attention to the macroeconomic aspect. For example, Korajczyk and Levy (2003) capture the macroeconomic environment in terms of three variables: the corporate profit growth rate, equity market returns, and the excess returns of commercial paper, to analyze how macroeconomic conditions and financial constraints affect capital structure choice. Cook and Tang (2010) studied the macroeconomic conditions and capital structure adjustment speed. Macroeconomic conditions have been found to be important factors in analyzing firms' financing choices.

The purpose of this thesis is to give empirical analysis on the relationship between business cycle and capital structure choice. However, we examine not only business cycle, but also how other specific macroeconomic and microeconomic variables affect companies' financing decisions collectively.

This thesis chooses the gaming industry and automotive industry in the U.S. stock market as research subject. Both two industries are highly sensitive to the business cycle due to their own specific characteristics.

The paper uses panel data model as estimation method, which can provide information on individual behavior, both across individuals and over time. The data and models have both cross-sectional and time-series dimensions. Panel data can be balanced when all individuals are observed in all time periods or unbalanced when individuals are not observed in all time periods.

This thesis mainly has parts of three chapters including the second chapter, the third chapter and the fourth chapter. The first two can be categorized as a theoretical part, and the last one is about the empirical part.

In the second chapter, basic theories of capital structure and current situation of target industries are introduced in detail. Hypotheses about the research results are made in this chapter based on those theories.

The third chapter provides knowledge of the methodology of panel data model. Then, we construct the model according to acquired information. Moreover, the analysis of sample data is also presented in this chapter.

We run the commands of panel data model estimation in Stata and then display the outputs in the fourth chapter. By the end of this chapter, the final results will be gathered together and discussed elaborately.

In the fifth, also known as the last chapter, we summarize the full text about the research on business cycle and capital structure choices, draw a conclusion, and proposes some questions need to discuss and research further.

2 Prior research review and hypotheses

The capital structure of a company can be defined as the composition of its capitalization and it includes all kinds of capital resources, such as debt, stocks, and equity.

This chapter first examines the modern theories of capital structure, from the theoretical Modigliani-Miller (MM) theorems devised by Modigliani and Miller in 1958 to the two of the extended popular theories—the statistic trade-off theory and the pecking order hypothesis. Then, prior researches related to factors affecting companies' capital structures are reviewed and introduced in detail. After that, the author provides analysis to the overall status of the U.S. market as well as targeting industries based on some official reports. With these as the basis, hypotheses are made in the final section of this chapter with applications of the aforesaid theories.

2.1 Theoretical basis

The capital structure of a company is the founding stone for the daily development of its operation, and for a further planning of the business. To understand the capital structure choice of firms, we need the help of basic theories introduced hereinafter.

The development of capital structure theory can be defined as two stages. The first stage is the period of old theories, which contains traditional capital structure theory and modern capital structure theory. The second stage is the period of new capital structure theories.

The traditional capital structure theory was formed before 1950s, mainly represented by net income theory (NI), net operating income theory (NOI) and the traditional theory (David Durand, 1952). This is the embryonic stage of capital structure theory. It is a kind of inference about the behavior of corporate management, mainly based on empirical judgment only. There is no theoretical deduction and statistical analysis of scientific system, but it also provides direction for the latter development of capital structure theory.

The classical MM theory put forward in 1958 marks the establishment of modern capital structure theory. The modern capital structure theory focuses on the reasons and process for the formation of the target capital structure.

With the development of economic theory, especially the in-depth study in economics of information, at the end of 1970s, asymmetric information theory began to be applied to corporate financing decisions, and gradually formed some new capital structure theories, mainly are agency costs theory, pecking order theory, market timing theory, and so on. These theories provide us with more perspectives on understanding the company's capital structure.

After decades of development and continuous integration with other economic theories, capital structure theory has formed a certain system. Some of the theories are wildly applied in prior empirical researches, for example the MM theory, the trade-off theory and pecking order theory. In this section, we mainly focus on these three theories.

2.1.1 The Modigliani-Miller Theorem

Modigliani and Miller (1958) proposed the well-known theory of capital structure—MM theory: in a completely effective market without any taxation, if the total amount of funds for forming a company is certain, then the value of a company with or without financial leverage are exactly equal, meaning that capital structure has nothing to do with corporate value under such circumstance.

The earliest MM theory was proposed for a perfect market under strict but usually unrealistic assumptions, among which the no-tax assumption is the key. However, if we move to the real world where there are taxes, as Fernandes and Nuno (2014) suggest, when the interest on debt is tax-deductible, and ignoring other frictions, the value of the company increases in proportion to the amount of debt used. And the source of additional value is due to the amount of taxes saved by issuing debt instead of equity.

In order to address some of the imperfections in the real-world market situation, the assumptions made in the MM model have to be relaxed, so as to take into consideration the impact of corporate income tax on the capital structure. Modified MM theories were therefore developed with taxation being the primary reason for the capital structure to actually matter in reality. Such modified theory mainly states that corporate liabilities can act as a tax shield, and tax shields can increase the value of a company. This is because debt interest can be deducted before tax, which also forms a tax-deductible income, so the company's debt can increase the company's market value under certain circumstances. Meanwhile, the more corporate debt, the stronger the action of the tax shield, and the higher the market value of the company.

Since the MM theory has been come up with, the research on the factors affecting the capital structure of enterprises has developed rapidly, and the theory of capital structure has been continuously enriched, followed by a large number of empirical studies using the data of listed companies as samples.

2.1.2 The Trade-Off Theory

From the perspective of funding sources, the financing methods of enterprises can be divided into internal financing and external financing. Internal funds refer to the funds generated by the business activities of the enterprise, that is, the funds that are internally financed by the enterprise, including retained earnings and depreciation. Internal funds form a company's seed money with the characteristics of low cost, autonomy, and anti-risk. The pecking order hypothesis states that companies choose internal funds preferentially to meet the capital needs of enterprises. Then, with the expansion of production scale and investment, when the needs exceed the threshold, the company raises the funds through external channels, to fill the remaining part.

External financing refers to the way in which enterprises raise funds from other economic entities. It mainly consists of equity financing and debt financing. Furthermore, debt financing can be divided into bond financing, bank loans, and trust financing.

The thought that static trade-off theory considers that corporate with higher operational risk would have higher bankruptcy costs, therefore, needs to lower its debt level, put forward by Haley and Schall (1979).

2.1.3 The Pecking Order Theory

Base on the assumption of perfect capital market in MM theory, Myers and Majluf (1984) put forward the pecking order theory following the findings of Donaldson (1961) which discovered that management internally generated funds instead of using external funds. Pecking order theory holds that there is information asymmetry between inside management and investors in the valuation of the enterprise, which leads to the game between the two parties, making the enterprise have obvious financing order preference. That is, internal financing, debt financing, and equity financing as the last resort. Myers and Majluf (1984) also fund that, equity is the last option for financing externally due to the fact that current shareholders are not willing to share the benefit of investment or decline the share price. The theory also holds that when a firm isn’t able to generate sufficient funds internally to fulfill its investment needs, it will choose to borrow more debt.

2.2 Prior researches

As has been mentioned in the previous section, since the proposal of the MM theory, the research on the factors affecting the capital structure choice of enterprises has developed rapidly. With time going by, the theory of capital structure has been enriched, followed by a large number of empirical studies based on the data of listed companies as samples. In this section, we review and sort out the research literatures on the factors affecting capital structure into company characteristic category and macroeconomic category.

2.2.1 Company characteristic factors affect capital structure choices

Marsh (1982) concludes that the company's size is positively related to the capital structure. He selects companies of different sizes, focuses on analyzing the company's long-term and short-term debt ratios, and find that as the company's size increased, the company's debt ratio also increased. He believes that the larger the company, the more it prefers to choose long-term debt, because the long-term debt leads to the economies of scale that can reduce the company's financing costs; on the contrary, small-size companies prefer to choose short-term debt because small companies face higher bankruptcy risks. And long-term debt will bring higher financing costs.

Kester (1986) selects companies in Japan and the United States as samples to conduct an empirical analysis of the company's financial leverage. He chooses the debt-to-equity ratio to represent financial leverage, and uses profitability, growth, and company size as explanatory variables, while using industry and country as dummy variables. Through linear regression results, it is found that profitability and company size are negatively correlated with financial leverage, while growth is positively correlated with financial leverage.

Howe (1988), based on the perspective of agency cost, analyzes and concludes that profitability is positively correlated with asset-liability ratio. He believes that corporate debt can force managers to use corporate profits to pay interest on debt, thus acting as a constraint on the management. Therefore, the higher the company's profitability, the higher its asset-liability ratio, which restricts the company's management's arbitrary decision to a certain extent and safeguards the company's interests.

Titman and Wesdssels (1982) select US manufacturing listed companies as research objects and empirically analyzed the factors affecting capital structure. They find that factors such as profitability, company size, growth, asset cover ability, non-debt tax shield and operational capability will affect the capital structure of listed companies.

Wald (1999) uses Tobit regression and the method that debt/asset ratios are regressed on the determinants of capital structure to study the data of non-public utilities and non-financial companies in France, Japan, Germany, the United Kingdom, and the United States. It is found that the ratio of net fixed assets to total assets was positively correlate with company’s leverage. Non-debt tax shields, R&D expenses as a percentage of sales revenue, and profitability are inversely related to leverage ratios. The study also discovers that the relationships between risk, company size, inventory to total assets ratio and capital structure are vary from country to country. This indicates that the institutions may also be a significant determinant of capital structure, and the agency costs of countries may also be different.

2.2.2 Macroeconomic factors affect capital structure choices

DeAngelo and Masulis (1980) argue that inflation has a major impact on a company's capital structure. When inflation increases, the real cost of debt financing will decrease, so the company will increase its liabilities to reduce financing costs; when inflation eases, lower stock market returns will prompt the company's management to choose corporate bonds with higher yields. That will also increase the company's liabilities. Therefore, inflation is positively correlated with corporate debt ratio.

Longstaff and Schwartz (1995) study the impact of interest rates and inflation rates on capital structure based on agency costs and management risk perspectives. They believe that changes in inflation and interest rates will change the tax shield revenue and the company's bankruptcy costs, thus affecting the company's capital structure.

A survey by Graham and Harvey (2001) shows that one-third of US manufacturing companies consider the impact of macroeconomic factors such as interest rates and inflation rates in their financial decisions. The report also confirms the impact of macroeconomic factors on the company's capital structure.

Korajczyk and Levy (2003) analyze the impact of macroeconomic factors on the capital structure of listed companies from the perspective of financial constraints. They find that regardless of whether the company's finances are constrained, the impact of macroeconomic factors on the company's capital structure is significant. At the same time, the study also find that if the company's financial constraints are high, the financial leverage is subject to a counter-cyclical change; if the financial constraints are low or the financial is not constrained, the financial leverage is subject to a cyclical change.

Booth (2001) uses empirical cross-sectional data from developed and developing countries for empirical analysis. He focuses on the impacts of macroeconomic variables such as stock market value as a percentage of GDP, real GDP growth rate, bank loan-to-GDP ratio, and inflation rate on capital structure. The results of the study show that these macroeconomic variables have a significant impact on 27.5% of corporate debt ratio changes in 17 countries, with a significant impact on 22.4% of companies' long-term debt ratio changes in 16 countries.

He found that the ratio of bank loans to GDP, real GDP growth rate were positively correlated to the company's asset-liability ratio, while stock value as a percentage of GDP and inflation rate were negatively correlated with the company's asset-liability ratio. Booth's research shows that the macroeconomic environment significantly affects the company's capital structure.

The study by Hackbarth et al. (2006) shows that if the changes in the macroeconomic environment have a great impact on the company's operating cash flow, the company will adjust its capital structure along with the macroeconomic environment changes. To this end, they construct a stochastic theoretical model. The results show that when the macroeconomic environment is good, the company's debt financing increases greatly. At the same time, the better macroeconomic environment prompts the company to adjust the capital structure more frequently. But the rangeability of adjustment is found to be smaller than when the economy is in recession.

2.3 Market overview

In this thesis we focus our attention on specific industries in the U.S. market. In this section, we give the macroeconomic situation of U.S. a glance by illustrating real gross domestic product and its change over time. And then we introduce the overall leverage level of all companies listed in the U.S. market, and compare it with other markets.

Table 2.1: U.S. real gross domestic product from FQ1 2007 to FQ4 2017

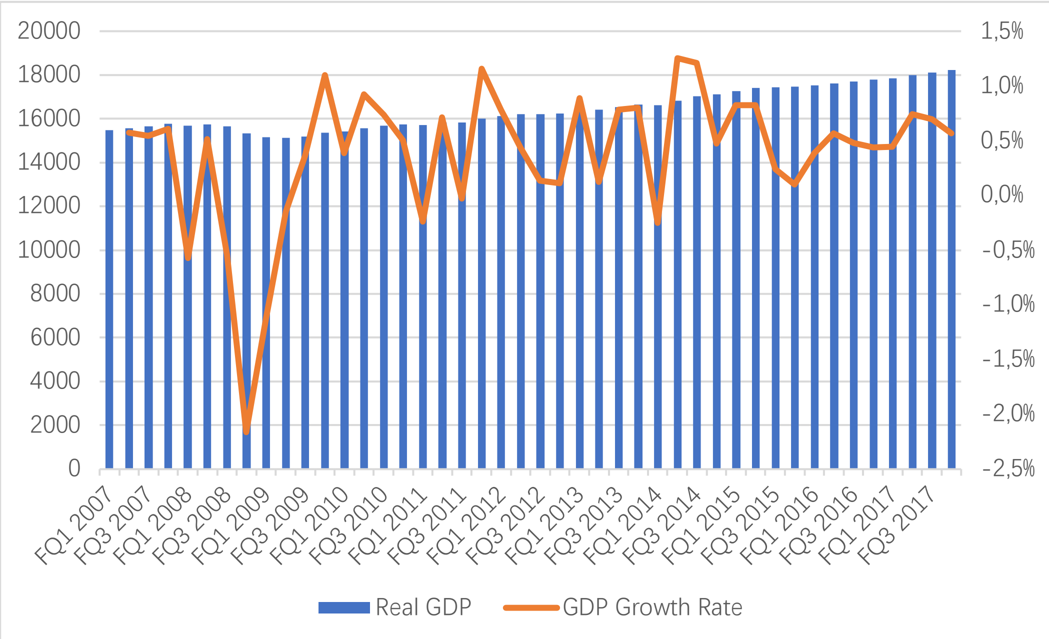
t	Real GDP	Growth Rate	t	Real GDP	Growth Rate
FQ1 2007	15493.33	-	FQ3 2012	16220.67	0.13%
FQ2 2007	15582.09	0.57%	FQ4 2012	16239.14	0.11%
FQ3 2007	15666.74	0.54%	FQ1 2013	16382.96	0.89%
FQ4 2007	15761.97	0.61%	FQ2 2013	16403.18	0.12%
FQ1 2008	15671.38	-0.57%	FQ3 2013	16531.69	0.78%
FQ2 2008	15752.31	0.52%	FQ4 2013	16663.65	0.80%
FQ3 2008	15667.03	-0.54%	FQ1 2014	16621.70	-0.25%
FQ4 2008	15328.03	-2.16%	FQ2 2014	16830.11	1.25%
FQ1 2009	15155.94	-1.12%	FQ3 2014	17033.57	1.21%
FQ2 2009	15134.12	-0.14%	FQ4 2014	17113.95	0.47%
FQ3 2009	15189.22	0.36%	FQ1 2015	17254.74	0.82%
FQ4 2009	15356.06	1.10%	FQ2 2015	17397.03	0.82%

Table 2.1 (continued)

FQ1 2010	15415.15	0.38%	FQ3 2015	17438.80	0.24%
FQ2 2010	15557.28	0.92%	FQ4 2015	17456.23	0.10%
FQ3 2010	15671.97	0.74%	FQ1 2016	17523.37	0.38%
FQ4 2010	15750.63	0.50%	FQ2 2016	17622.49	0.57%
FQ1 2011	15712.75	-0.24%	FQ3 2016	17706.71	0.48%
FQ2 2011	15825.10	0.71%	FQ4 2016	17784.19	0.44%
FQ3 2011	15820.70	-0.03%	FQ1 2017	17863.02	0.44%
FQ4 2011	16004.11	1.16%	FQ2 2017	17995.15	0.74%
FQ1 2012	16129.42	0.78%	FQ3 2017	18120.84	0.70%
FQ2 2012	16198.81	0.43%	FQ4 2017	18223.76	0.57%

Source: Federal Reserve Bank of St. Louis

Chart 2.1: U.S. real gross domestic product from FQ1 2007 to FQ4 2017



Source: Federal Reserve Bank of St. Louis

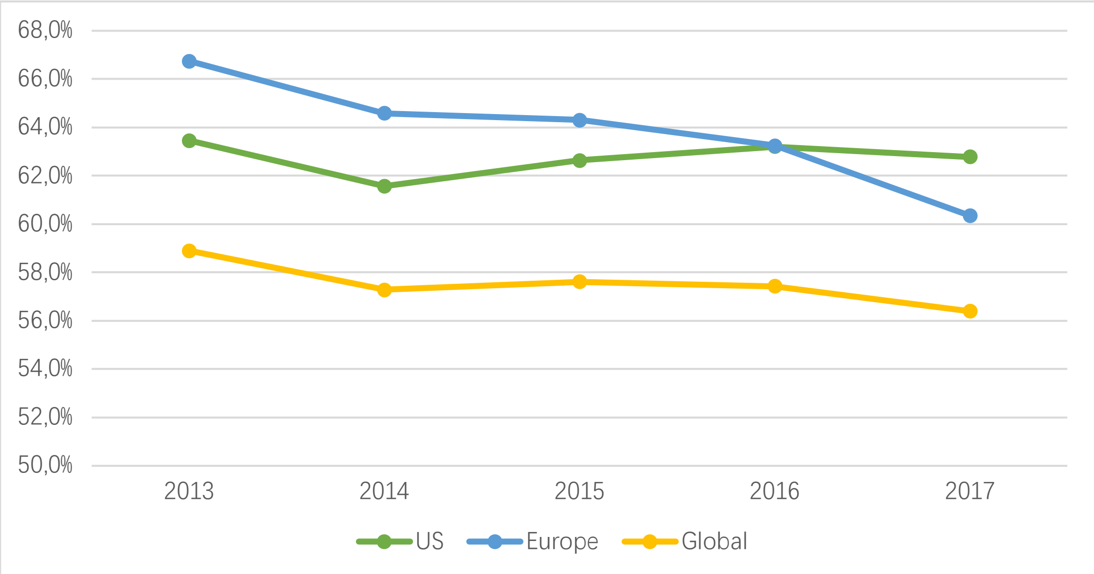
Real gross domestic product (GDP) shows an overall increasing trend with small quarterly fluctuations from FQ1 2017 to FQ4 2017. The GDP growth rate measures how fast the economy is growing, by comparing one fiscal quarter of GDP to the previous fiscal quarter. The real GDP significantly decreased in 2008 due to the financial crises. Since FQ3 2009, the real GDP increased steadily, only experienced very slightly drop in FQ1 2011, FQ3 2011 and FQ1 2014. This illustrates U.S. is in a good macroeconomic situation, the recession risk remains low.

Table 2.2: Book value debt ratio of companies in different markets

	US	Europe	Global
2013	63.460%	66.748%	58.901%
2014	61.572%	64.582%	57.287%
2015	62.633%	64.302%	57.621%
2016	63.211%	63.246%	57.423%
2017	62.783%	60.350%	56.396%

Source: Damodaran online, data: archives

Chart 2.2: Book value debt ratio of companies in different markets



Source: Damodaran online, data: archives

Table 2.2 shows aggregate book leverage ratios for all firms and industries in the dataset created by Aswath Damodaran. Aggregate book debt-to-capital ratio is a measurement of a company's financial leverage, which is defined each year as the cross-section sum of the company's interest-bearing debt, both short- and long-term liabilities, divided by total capital. Total capital is all interest-bearing debt plus shareholders' equity, which may include items such as common stock, preferred stock, and minority interest. Chart 2.2 examines the trends in aggregate book debt-to-capital ratio of firms in U.S., European, and global markets.

The table and chart above illustrate that from 2013 to 2017, the mean leverage of all firms globally is fairly low, lower than either of US and European markets. It shows a downward trend, ranging from 58.901% to 56.396%. From 2013 to 2017, Book leverage of European market decreased sharply, from 66.784% to 60.350%. Especially during 2016 to 2017, the leverage decreased approximately 3%. The leverage of US market decreased from 63.460% in 2013 to 61.572% in 2014, however, from 2014 to 2016, it increased significantly to.63.211%, nearly reaching the peak of 63.460% in 2013. Though it slightly dropped in 2017, the leverage of US market surpassed European market. Since 2017, US has replaced Europe and became the market in which companies have the highest leverage.

Table 2.2 and Chart 2.2 together serves well to illustrate that in recent years, the integral leverage level of companies listed in U.S. market was relatively high and became the highest compared to Europe and Global in 2017.

2.4 Actuality of targeting industries

2.4.1 The U.S. gaming industry

In line with the new study, *Economic Impact of the US Gaming Industry*, from oxford economics, the American gaming industry has significant impact on the economy as a powerful economic engine and a dynamic job creator. It provides nearly 1.8 million jobs across the country and contributes $261 billion to the U.S. economy. According to the 2018 State of State report released by American Gaming Association (AGA), the total revenue of the commercial gaming industry in 2017 was $40.28 billion. The tax payment totaled up to $9.23 billion to the state. The report shows there was 20 commercial casino states experienced revenue increases in 2017, reflecting strong macroeconomic trends and sustained job growth in most parts of the country.

A distinct feature of the U.S. gaming industry mentioned by Schwartz and Christiansen (2012) is that some companies' debt load grew massively from 2005 to 2009 and led the industry's leverage to a historical high level.

Horvath and Paap (2012) examine the influence of the business cycle on expenditures of three major types of legalized gambling activities and conclude that the casino gambling expenditures show a positive growth during expansions and no growth during recessions. Hence, the loss in income during recessions affects casino gambling. This research proves that the gaming industry is sensitive to the business cycle.

2.4.2 The U.S. automotive industry

According to an official report, North American automotive market continues to record steady growth in 2018. Automotive is one of America's largest manufacturing industries, and has been considered as one of the pillar industries for a long time. Auto sales were hit by financial crisis in 2008, then recovered in a short time and have seen an increase by more than 67% since the crisis ended. In 2017 alone, U.S. light vehicle sales reached 17.1 million units, the third straight year in which sales reached or surpassed $17 million (Ward's Automotive Reports, January 8, 2018).

At the worldwide angle, automotive is one of the world's largest economic industries with regard to revenue. With the development of international trade, listed automotive companies are strongly dependent upon the international environment. Thus, worldwide car sales were also affected by the 2008 financial crisis, and fell dramatically during 2008-2009. Thanks to the rapid demand growth in Asian market in recent years, by far the value of automobiles sold has been back to the pre-crisis level. The report shows in 2017, the United States exported nearly 2 million new light vehicles and almost 130,000 medium and heavy trucks (valued at $63.2 billion) to more than 200 markets worldwide, with additional exports of automotive parts valued at $85.6 billion.

The automotive industry is identified as a capital-intensive industry that required great investments of money for machinery and equipment. That is to say, more debt is needed by it than by other industries. Therefore, the automotive industry is expected to stay at a high level of leverage ratio.

In accordance with the paper, *A View of Recessions, from the Automotive Industry*, by Martin B. Zimmerman, chief economist of Ford Motor Company, the recession of the macroeconomy would have huge impact on the auto industry. In his opinion, the auto industry is the one that most cyclical and most dependent on the business cycle. Since the industry is highly sensitive to the business cycle, it is interesting to find out how exactly it will react to the change of macroeconomic factors.

2.5 Hypotheses

In this section, we state our hypotheses, trying to explain each proposition that we are interested in respectively by literature findings introduced in section 2.1. As the external environment of a firm's financing activities, the macroeconomic environment should have an important impact on the capital structure choice of enterprises. This paper studies the impact of macroeconomic environment on the capital structure of gaming and automotive listed companies under the control of firm-specific factors. The macroeconomic factors in this paper should be mainly focused on the business cycle, credit market and stock market and other aspects related to capital structure. The firm specific microeconomic factors such as profitability, firm size, and growth should be included in as well. Moreover, through this thesis, we measure the capital structure as leverage ratio, using a company's total liabilities divided by its total assets.

2.5.1 Business cycle and capital structure

A company would have different operating capacity in different stage of business cycle. When during the expansion period, a company normally has higher profitability and lower operational risk than in recession phase.

As we mentioned earlier, based on the trade-off theory, a company's capital structure would change along with the business cycle. Because when macroeconomy is in a boom, profitability that stronger than before allows company to bear greater interest burden. Meanwhile, the relatively low business risk would encourage the company to expand debt financing, so as to make full use of tax shield. Therefore, in the expansion stage, a company's leverage will increase, and the value of company increases as well, and vice versa.

In contrast, the pecking order theory supports the idea that since the companies have a preference for internal financing, higher profitability and sufficient capital would lead to a cutting down of the leverage ratio. Hence, under the pecking order hypothesis, the corporate leverage shows an anticyclical trend. Form the above, we come up with hypotheses as follows:

Hypothesis 1a: Based on the trade-off theory, the business cycle is positively related to the capital structure.

Hypothesis 1b: Based on the pecking order theory, the business cycle is negatively related to the capital structure.

2.5.2 Interest rate and capital structure

Interest rate can be treated as the cost of debt form the corporate point of view and has great impact on capital market. The most direct impact of interest rate adjustment is to change the cost of corporate debt financing, which in turn affects the choice of financing methods and changes in capital structure. According to the trade-off theory, the increase in interest rate will increase the debt financing cost of enterprises. If the enterprise seeks the optimal capital structure, it will inevitably reduce the debt ratio of the enterprise to maintain the value of the enterprise without falling. Based on the analysis of the financing priority theory, the impact of rising interest rates. It is not only to improve the debt financing cost of enterprises, but also to reduce investors' expectations of corporate profitability, which in turn leads to a decline in corporate stock prices. At this time, enterprises will try to choose internal financing or reduce external financing, and thus the financial leverage of enterprises will decline. Therefore, both the trade-off theory and the theory of priority financing can explain the negative correlation between interest rates and the capital structure of enterprises.

But the interest rate we use in this thesis is the U.S. 10-year government bonds rate, instead of the bank lending rate. As we know, investors have a wide variety of investment choices, from corporate stocks to government bonds. When the yield of treasury bond (T-bonds) increases, investors will invest their money in bonds market instead of stock market, thereby the stock price may drop, and the company need to finance by debt.

Hypothesis 2: Long-term interest rate and capital structure are positively correlated.

2.5.3 Profitability and capital structure

As mentioned earlier, according to the trade-off theory, the profitability of a profitable company is low, so the debt cost is expected to be low, so the leverage ratio is high (Frank & Goyal, 2009). In contrast, the pecking order theory predicts that higher profitability will lead to a decline in leverage as companies tend to use internal rather than external funds. Most empirical studies support the theory of foraging order (Fama & French, 2002; Titman & Wessels, 1998; Wald, 1999). In terms of transportation, Drobetz et al. (2013) asserts that profitability and leverage are inversely related. Based on all of the above and taking into account a unique and recognized feature of shipping, that is, the mood of the shipowner at different stages of the business cycle, we form the following assumptions:

Hypothesis 3a: Based on the trade-off theory, the profitability is positively related to the capital structure.

Hypothesis 3b: Based on the pecking order theory, the profitability is negatively related to the capital structure.

2.5.4 Corporate size and capital structure

According to the trade-off theory, large firms commonly own stable cash flows with high risk resistance capacity. Since being less likely to go bankrupt, large firms have stronger ability to borrow from banks with lower costs compared with small and medium enterprises (SMEs). The larger the scale of the enterprise, the easier it is to obtain the support of the bank for credit. The enterprise with large size has stronger ability to integrate resources, has better credit rating, and therefore, is more likely to obtain loans. This result in higher leverage in large firms.

Hypothesis 4: Based on the trade-off theory, the firm size is positively related to the capital structure.

3 Sample description and methodology

There are three sections included in this chapter, methodology, model construction, and sample description. It contains all the methods and sources needed in the practical part.

3.1 Methodology

In accordance with empirical study on the factors affecting company's capital structure, we found the panel data analysis is the most suitable method for such research.

In this section, we introduce estimation method of panel data models, primarily focusing on the one-way error component regression model.

3.1.1 Introduction

Panel data refers to the pooling of observations on a cross-section over several time series. For example, as what we do in this thesis, surveying a number of firms (N) and following them over time (t). Panel data regression differs from a regular time-series or cross-section regression in that it has a double subscript on its variable.

The most basic structure of panel data modelled as:

$$y_{it} = X_{it}\beta + Z_i\alpha + u_{it}, \tag{3.1}$$

where i represents firms, and t represents time. Therefore, the i subscript denotes the cross-section dimension, while t denotes the time-series dimension. β is a $K \times 1$ matrix, X_{it} is the itth observation on K explanatory variables, α is a scalar, $Z_i\alpha$ represents heterogeneity, and u_{it} is the error term.

Primarily, we assume the panel is balanced, which means each individual i is observed in all time t. Then, for unobserved effects models the data can be generated by following assumptions:

P1: Linearity

$$E(u_{it}) = 0 \text{ and } E(\alpha_i) = 0 \tag{3.2}$$

The model is so-called linear in parameter β, effect α_i and error u_{it}.

P2: independence

$$\{X_i, y_i\}_{i=1}^{N} \ i.i.d \tag{3.3}$$

The observations are independent and identically distributed across individuals but not necessarily across time.

P3: Strict exogeneity

$$E(u_{it}|X_i, \alpha_i) = 0 \tag{3.4}$$

The error term is assumed uncorrelated with explanatory variables of the same individual, regardless of time.

The strict exogeneity assumption followed by unobserved effects models can be stated in terms of conditional expectations as

$$E(y_{it}|\ X_{i1}, X_{i2}, \dots, X_{iT}, \alpha_i) = E(y_{it}|\ X_{it}, \alpha_i) = X_{it}\beta + \alpha_i. \tag{3.5}$$

There are in general three types of panel data models: pooled regression model, fixed effects model and random effect model.

(1) The pooled regression models

It is the simplest way by pooling regression on all the observations together. In this case, it assumes that there is no heterogeneity:

$$y_{it} = X_{it}\beta + \alpha + u_{it} \qquad (i = 1, \dots, N; t = 1, \dots, T), \tag{3.6}$$

If there is no significant difference between different individuals in terms of time or between different sections, then pooled ordinary least squares (Pooled OLS) estimator can be used to analyze this model.

(2) The fixed effects model

The fixed effects model is one of the unobserved effects models, the other one is random effects model. A key difference between these two methods is that, for random effects, α_i is treated as a random variable, and for fixed affects, it is viewed as parameter to be estimated for each cross-section observation i.

$$y_{it} = X_{it}\beta + \alpha_i + u_{it} \qquad (i = 1, \dots, N; t = 1, \dots, T), \tag{3.7}$$

where α_i is the unobserved time-invariant individual-specific effect (unobserved heterogeneity).

This model assumes the individual effect α_i is correlated with the independent variable X_{it}. Which means the covariance between α_i and X_{it} should not be equal to 0. Therefore,

$$Cov(\alpha_i, X_{it}) \neq 0. \tag{3.8}$$

(3) The random effects model

In the random effect model, the individual-specific effect is a random variable that is uncorrelated with the explanatory variables. The model can be written as

$$y_{it} = X_{it}\beta + \alpha_i + u_{it} \qquad (i = 1, \dots, N; t = 1, \dots, T). \tag{3.9}$$

The basic assumption of random effect is that,

$$Cov(\alpha_i, X_{it}) = 0, \tag{3.10}$$

or,

$$E(\alpha_i | X_i) = E(\alpha_i), \tag{3.11}$$

indicating the covariance between α_i and the independent variable X_{it} has to be equal to 0. This assumption ensure that the random effect estimate of β is consistent.

3.1.2 Estimation method

(1) Pooled OLS

The ordinary least squares (OLS) is defined as a type of linear least squares method for estimating the unknown parameters in a linear regression. Pooled OLS model is one where the data on different units are pooled together with no assumption on individual differences and estimated by OLS. The model gives

$$y_{it} = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \cdots + \beta_k X_{kit} + u_{it}, \tag{3.12}$$

where y_{it} is the dependent variable, X_{kit} is the $k-th$ explanatory variable, β_k is the structural parameter, k is the number of independent variables and u_{it} is the error term.

(2) Fixed effects estimator

The fixed effects estimator is also called within OLS estimator. The main idea is to eliminate the unobserved effects α_i (which can be added back in later), and then using Pooled OLS estimator on the time-demeaned variable.

Subtracting the time-mean of each entity away from the values of variable. Then, define the time-mean of the observation for cross-sectional unit i as

$$\bar{y}_i = \frac{1}{T}\sum_{t=1}^{T} y_{it}, \tag{3.13}$$

Thus, for the simple regression, averaging over time gives

$$\bar{y}_i = \bar{X}_i\beta + \alpha_i + \bar{u}_i \qquad (i = 1, \dots, N; t = 1, \dots, T) \tag{3.14}$$

Therefore, subtracting (3.14) from the original model (3.7), we will get time-demeaned variable

$$y_{it} - \bar{y}_i = \beta(X_{it} - \bar{X}_i) + (u_{it} - \bar{u}_i), \tag{3.15}$$

which can be rewritten as

$$\tilde{y}_{it} = \beta\tilde{X}_{it} + \tilde{u}_{it}. \tag{3.16}$$

(3) Random effect estimation

The random effect estimator takes on the name of the feasible generalized least square (FGLS) estimator. This method involves more assumptions than those needed for Pooled OLS:

Assumption RE1:

a. $E(u_{it}|\, X_i, \alpha_i) = 0, t = 1, \dots, T.$

b. $E(\alpha_i|\, X_i) = E(\alpha_i) = 0.$

In the random effects estimation, α_i is moved into the composite error term. Now, the function becomes,

$$y_{it} = X_{it}\beta + v_{it}, \tag{3.17}$$

$$E(v_{it}|\, X_i) = 0, \tag{3.18}$$

where

$$v_{it} = \alpha_i + u_{it}. \tag{3.19}$$

Assumption RE2:

$$Corr(v_{it}, v_{is}) = \frac{\sigma_\alpha^2}{\sigma_\alpha^2 + \sigma_u^2}, \tag{3.20}$$

for all $t \neq s$, where $\sigma_\alpha^2 = var(\alpha_i)$ and $\sigma_u^2 = var(u_{it})$.

Then, we can estimate it by FGLS.

3.1.3 Tests in panel models

(1) Unit root test

It is a common assumption in time series analysis that the data is stationary. Intuitively, the stationarity indicates that the statistical properties of a process, such as mean, variance and covariance, generating a time series remain unchanged over time. It can be also described as a flat looking series without trend, or periodic fluctuations. Stationarity can be helpful in building not only a permanent model, but also a more prominent one.

Models can show different types of stationarity. The first one would be strict stationarity, which means that the joint distribution of any moments within the process is irrelevant with time. However, this definition is considered in practice too strict to be used in reality.

The second type is called weak stationarity. Under such circumstance, time series have constant statistical properties (e.g. mean, variance and autocovariance) that do not change along with time. Other statistics in the system are free to change over time. This constrained type of strict stationarity is widely applied in practice.

So before constructing the panel data model, it is initial to test the stationarity of data set by the help of a hypothesis test.

The unit root, also known as the unit root process, is a stochastic trend in a time series. If a time series has a unit root, then it is non-stationary. Many tests exist in this area, for instance the Augmented Dickey-Fuller (ADF) test, Phillips-Perron (PP) test, KPSS test and so on. They can be used to determine if trending data should be first differenced or regressed on deterministic functions of time to render the data stationary.

Consider an AR(1) model of y_t:

$$y_{i,t} = \rho_i y_{i,t-1} + \varepsilon_{i,t}, \ \ \varepsilon_{i,t} \sim N(0, \sigma^2). \tag{3.21}$$

Unit root tests take the null hypothesis that $H_0: \rho_i = 1 \ (difference\ stationary)$ against the alternative hypothesis that $H_1: |\rho_i| < 1 \ (trend\ stationary)$.

If $\rho_i = 1$, in that way $y_{i,t} = y_{i,t-1} + \varepsilon_{i,t} = y_0 + \sum_{j=1}^{t} \varepsilon_{i,j}$, has a stochastic trend.

However, for panel model, there is a series of specific panel-data unit-root tests implemented in Stata. It contains the Levin–Lin–Chu (2002), Harris–Tzavalis (1999), Breitung (2000; Breitung and Das 2005), Im–Pesaran–Shin (2003), Fisher-type (Choi 2001), Hadri (2000), and Lagrange multiplier (LM).

We will apply the most common test - LLC (2002) in our practice part which has as the null hypothesis that panel contain a unit root. Levin, Lin, and Chu propose a test which has an alternative hypothesis that the ρ_i are identical and negative. Because ρ_i is fixed across i, this is one of the most complicated of the tests because the data from the different individuals need to be combined into a single final regression. In Stata, we simply run the command of llc.

(2) Hausman test

The random effects model can be consistently estimated by both the RE estimator or the FE estimator. We would prefer the RE estimator if we can be sure that the individual-specific effect really is an unrelated effect. This is usually tested by a (Durbin-Wu-) Hausmann test.

An initial difference between two specific-effects models is whether the unobserved individual effects α_i is correlated with the X_{it}. In order to testing this assumption, Hausman (1978) proposed a test based on such difference. When $Cov(\alpha_i, X_{it}) \neq 0$, $\hat{\beta}_{FE}$ is consistent, while $\hat{\beta}_{RE}$ is inconsistent.

Hence, the Hausman test statistic is given by

$$w = q'[var(\hat{\beta}_{FE}) - var(\hat{\beta}_{RE})]^{-1} q \sim \chi^2, \tag{3.22}$$

with $q = \hat{\beta}_{FE} - \hat{\beta}_{RE}$, $\hat{\beta}_{FE}$ denotes the fixed effects estimated value of the parameter β, and same as the $\hat{\beta}_{RE}$. The statistic w is distributed χ^2 under the null of RE, with degrees of freedom determined by the dimension of β, k.

And the null and alternative hypothesis is defined as:

$H_0: Cov(\alpha_i, X_{it}) = 0$,

$H_1: Cov(\alpha_i, X_{it}) \neq 0$,

If the value of w is close to 0, it indicates that null hypothesis is true. Then we conclude the random effects should be used. If we get a large value of w, we are going to reject the null hypothesis, which means fixed effects is the optimal choice.

However, the Hausman test is only valid under homoscedasticity and cannot include time fixed effects. Mundlak (1978) considered a one-way error component model with the additional auxiliary regression, but we won't go deeper here.

3.2 Model construction

3.2.1 Financial modelling

In Chapter 2, we introduced the theoretical basis of corporate capital structure choice and discussed the hypotheses of its influence factors. Combining all the information provided previously with the methodology from this chapter, we build a single-equation static panel data model for latter practical analysis. The model is aimed to help studying the impact of macroeconomic variables on corporate capital structure, by setting microeconomic factors as control variable. It shows as:

$$LEV_{it} = X_{it}\alpha + Micro_{it}\beta + u_{it}, \tag{3.23}$$

in which LEV_{it} represent the leverage ratio of firm i at time t. X_{it} stands for macroeconomic variables which have effects on companies' capital structure, such as business cycle, interest rate, inflation rate, default risk, etc. $Micro_{it}$ stands for firm-specific variables, for example, a firm's size, profitability, liquidity, risk level, and so on.

3.2.2 Variables

(1) Dependent variables

We measure a company's leverage (LEV) by total debt ratio, which compares a company's total liability to its total assets.

(2) Macroeconomic factors

In accordance to Mokhova and Zinecker (2014), which study provides extensive literature research on macroeconomic factors and capital structure, we decide to use the real gross domestic product (GDP) year-on-year growth rate (GR_GDP) and long-term interest rate

(LTIR) as independent variables. They both are commonly used and can represent prevailing business cycle stage in the economy.

(3) Microeconomic factors

Our model also takes firm-specific microeconomic factors into consideration as control variables.

Size (SIZE) is measured by the natural logarithm of a company's total assets. The company with lager size is considered to have less possibility to go bankruptcy, thus has higher leverage.

Profitability, measured by return on assets, plays a key role in company's decision making on capital structure. It is computed as total liabilities over total assets in our model.

The definition of the above variables is shown in Table 3.1.

Table 3.1: Definition of variables.

Variables	Name	Symbol	Measurement
Dependent variables	Leverage	LEV	Total liabilities over total assets
Independent variables	GDP	GR_GDP	Year-on-year growth rate
	Rate	LTIR	Long-term interest rate
Control variables	Size	SIZE	Natural logarithm of total assets
	Profitability	ROA	Return on assets

3.3 Sample description

Our sample consists of quarterly data of 14 companies in gaming industry and 12 companies in automotive industry during the period 2007-2017. All companies observed are listed in the United States' major stock markets. The firm-specific microeconomic data is collected, organized and published by Bloomberg. And the source of macroeconomic data is Federal Reserve Economic Data (FRED).

In this thesis, we chose companies published before FQ1 2007 and operated healthily during Q4 2017 only.

Table 3.2: Sample descriptive statistics: leverage ratio of gaming industry.

T	N	MEAN	MIN	MAX	STDEV
FQ1 2007	14	0.569	0.115	1.143	0.296
FQ2 2007	14	0.587	0.097	1.169	0.294
FQ3 2007	14	0.592	0.143	1.193	0.290
FQ4 2007	14	0.619	0.136	1.518	0.348
FQ1 2008	14	0.623	0.134	1.639	0.380
FQ2 2008	14	0.622	0.140	1.571	0.368
FQ3 2008	14	0.596	0.173	1.576	0.378
FQ4 2008	14	0.594	0.173	1.659	0.385
FQ1 2009	14	0.601	0.154	1.749	0.404
FQ2 2009	14	0.604	0.157	1.780	0.400
FQ3 2009	14	0.576	0.179	1.534	0.359
FQ4 2009	14	0.498	0.128	0.828	0.255
FQ1 2010	14	0.497	0.086	0.834	0.246
FQ2 2010	14	0.495	0.057	0.857	0.259
FQ3 2010	14	0.491	0.062	0.867	0.263
FQ4 2010	14	0.507	0.065	0.870	0.270
FQ1 2011	14	0.527	0.070	0.872	0.239
FQ2 2011	14	0.488	0.112	0.770	0.190
FQ3 2011	14	0.480	0.057	0.790	0.207
FQ4 2011	14	0.485	0.060	0.786	0.213
FQ1 2012	14	0.487	0.058	0.940	0.247
FQ2 2012	14	0.486	0.055	0.920	0.250
FQ3 2012	14	0.482	0.063	0.910	0.259
FQ4 2012	14	0.546	0.063	0.986	0.261
FQ1 2013	14	0.538	0.072	0.964	0.263
FQ2 2013	14	0.564	0.146	0.977	0.266
FQ3 2013	14	0.553	0.120	0.970	0.269
FQ4 2013	14	0.585	0.103	1.250	0.335
FQ1 2014	14	0.597	0.103	1.361	0.351
FQ2 2014	14	0.600	0.107	1.206	0.312
FQ3 2014	14	0.617	0.118	1.337	0.334
FQ4 2014	14	0.661	0.118	1.429	0.385
FQ1 2015	14	0.582	0.120	1.020	0.282
FQ2 2015	14	0.591	0.112	1.027	0.275
FQ3 2015	14	0.648	0.230	1.132	0.305
FQ4 2015	14	0.663	0.270	1.193	0.328
FQ1 2016	14	0.600	0.113	1.206	0.342
FQ2 2016	14	0.620	0.149	1.223	0.335
FQ3 2016	14	0.619	0.163	1.237	0.327
FQ4 2016	14	0.618	0.177	1.273	0.331

Table 3.2 (continued)

T	N	MEAN	MIN	MAX	STDEV
FQ1 2017	14	0.653	0.284	1.282	0.305
FQ2 2017	14	0.659	0.287	1.283	0.300
FQ3 2017	14	0.639	0.260	1.280	0.296
FQ4 2017	14	0.651	0.253	1.262	0.296

Source: Bloomberg

Table 3.2 collects sample mean (MEAN), minimum value (MIN), maximum value (MAX) and standard deviation (STDEV) of all samples (N) at each quarter (T).

According to the data above, the maximum values in each quarter are quite high, most of which are even higher than 1. However, the minimum values are extremely low. The huge gap between the minimum and maximum values indicates large differences on capital structures among companies in this industry. High level of standard deviation also reveals such situation. Mean leverage ratio fluctuates within the range of 0.48-0.70, which is at a relatively high level.

Table 3.3: Sample descriptive statistics: leverage ratio of automotive industry.

T	N	MEAN	MAX	MIN	STDEV
FQ1 2007	12	0.724	1.012	0.479	0.138
FQ2 2007	12	0.721	1.005	0.481	0.137
FQ3 2007	12	0.712	0.996	0.525	0.127
FQ4 2007	12	0.715	0.982	0.580	0.116
FQ1 2008	12	0.712	0.978	0.585	0.114
FQ2 2008	12	0.715	1.012	0.604	0.120
FQ3 2008	12	0.719	1.018	0.602	0.120
FQ4 2008	12	0.735	1.077	0.614	0.129
FQ1 2009	12	0.739	1.079	0.614	0.130
FQ2 2009	12	0.735	1.046	0.600	0.124
FQ3 2009	12	0.740	1.035	0.615	0.118
FQ4 2009	12	0.754	1.040	0.635	0.110
FQ1 2010	12	0.756	1.028	0.638	0.109
FQ2 2010	12	0.754	1.019	0.627	0.111
FQ3 2010	12	0.744	1.010	0.625	0.108
FQ4 2010	12	0.731	1.004	0.542	0.115
FQ1 2011	12	0.724	0.985	0.541	0.113
FQ2 2011	12	0.716	0.968	0.534	0.111
FQ3 2011	12	0.713	0.963	0.516	0.115
FQ4 2011	12	0.714	0.916	0.502	0.107
FQ1 2012	12	0.710	0.909	0.497	0.108

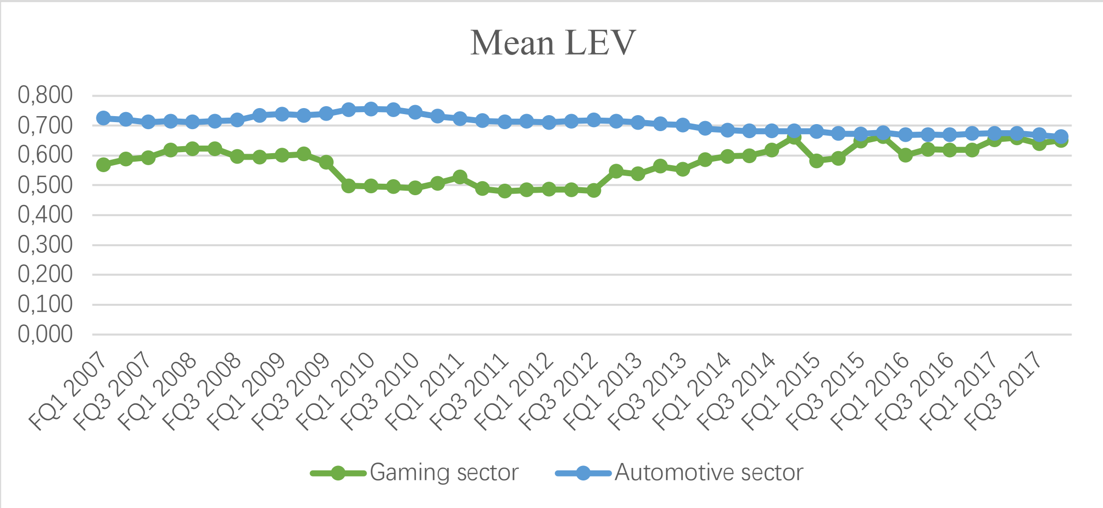
Table 3.3 (continued)

T	N	MEAN	MAX	MIN	STDEV
FQ2 2012	12	0.715	0.906	0.517	0.106
FQ3 2012	12	0.718	0.897	0.523	0.103
FQ4 2012	12	0.715	0.915	0.517	0.101
FQ1 2013	12	0.711	0.908	0.516	0.100
FQ2 2013	12	0.706	0.901	0.508	0.100
FQ3 2013	12	0.702	0.897	0.498	0.099
FQ4 2013	12	0.691	0.870	0.478	0.097
FQ1 2014	12	0.685	0.870	0.470	0.100
FQ2 2014	12	0.682	0.873	0.477	0.100
FQ3 2014	12	0.682	0.874	0.471	0.103
FQ4 2014	12	0.682	0.882	0.480	0.102
FQ1 2015	12	0.681	0.883	0.464	0.113
FQ2 2015	12	0.673	0.879	0.465	0.110
FQ3 2015	12	0.672	0.876	0.453	0.116
FQ4 2015	12	0.677	0.872	0.477	0.119
FQ1 2016	12	0.669	0.877	0.453	0.130
FQ2 2016	12	0.670	0.870	0.495	0.126
FQ3 2016	12	0.669	0.866	0.472	0.125
FQ4 2016	12	0.673	0.877	0.479	0.123

Source: Bloomberg

Seen from above, the values of standard deviation are around 0.1, indicating that the difference of leverage ratio is rather small among companies in the automotive industry. In each quarter, the maximum value of leverage is higher than 0.8 and the mean value is approximate to 0.7, showing that the automotive companies listed in the U.S. market generally have a high debt-to-assets ratio.

Chart 3.1: Mean leverage ratio of gaming and automotive industries.



Source: Bloomberg

Chart 3.1 illustrates how the mean leverage ratios of both gaming and automotive industries have changed over the period from FQ1 2007 to FQ4 2017. For the gaming industry, the chart shows an overall increasing trend with little fluctuations. To be specific, the mean leverage ratio reached the trough in 2012, and gradually rose from 2012 to 2017. The blue curve demonstrates the mean leverage of the automotive industry slightly increased from 2008 to 2010, and after culminating in 2010 then gradually declined till 2017.

From a general perspective, the automotive industry had a higher leverage level than the gaming industry did in the period. However, during recent years the two curves were converging, reflecting the fact that the difference between two industries' mean leverages tends to diminish to a minimal level.

4 Results and discussion

In this chapter, we apply the sample data into panel data methods described in Chapter 3, and then discuss about the resulting information.

As our thesis is focused on two targeting industries: the gaming industry and the automotive industry, we will set up one model for each industry separately and compare them with each other in the section of discussing.

For building and optimizing an econometrics model to figure out how macroeconomic factors affect corporate leverage in the U.S. specific industries, we need to follow a series of process.

First of all, we summarize the data and check if the panel is balanced. Secondly, we use the correlation command to display the covariance matrix for all variables. By doing so, we can examine whether the effect of autocorrelations is critical or not. After that, three methods will be operated respectively to build three different models. In the end, a Hausman test will tell us which model is better between FE and RE.

4.1 Gaming industry

4.1.1 Data summary

Table 4.1: Summary of data from gaming industry

```
. xtsum LEV GR_X1GDP X2LTIR ROA SIZE
```

Variable		Mean	Std. Dev.	Min	Max	Observations	
LEV	overall	.5752623	.3014781	.0547424	1.779586	N =	616
	between		.2488494	.2277483	.9210597	n =	14
	within		.1824632	-.2331753	1.433788	T =	44
GR_X1GDP	overall	1.74457	8.812245	-13.80772	10.22775	N =	560
	between		0	1.74457	1.74457	n =	14
	within		8.812245	-13.80772	10.22775	T =	40
X2LTIR	overall	2.777652	.867698	1.563333	4.846667	N =	616
	between		0	2.777652	2.777652	n =	14
	within		.867698	1.563333	4.846667	T =	44
ROA	overall	-.0019966	.0500055	-.4940712	.3866837	N =	616
	between		.0215777	-.0701098	.0150388	n =	14
	within		.0454698	-.4259581	.3855933	T =	44
SIZE	overall	6.723563	2.370218	3.457962	10.28055	N =	616
	between		2.422823	3.66514	10.12117	n =	14
	within		.397859	5.722192	9.013001	T =	44

Table 4.1 shows our data set contains in total 14 observed firms and 44 time periods. The overall mean of leverage ratio is 0.58, which is very close to the result we got in chart 3.1. The average GDP year-on-year growth rate is 1.74, indicating the GDP is almost twice as much as which from the same fiscal quarter of the previous year. The value of average ROA is negative in this industry, shows a general characteristic of low profitability of American listed gaming companies during 2007-2017.

4.1.2 The unit root test

We implement Levin–Lin–Chu (2002) test for unit root or stationarity in panel dataset within in this subsection. The test sets the hypotheses as,

H_0: $Panel\ contain\ unit\ roots\ (the\ panel\ is\ nonstationary)$,

H_1: $Panel\ doesn't contain\ unit\ root\ (the\ panel\ is\ stationary)$.

Table 4.2: Unit root test for LEV

```
Levin-Lin-Chu unit-root test for LEV
------------------------------------
Ho: Panels contain unit roots           Number of panels  =     14
Ha: Panels are stationary               Number of periods =     44

AR parameter: Common                    Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 11.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t        -15.6850
 Adjusted t*         -11.7673       0.0000
------------------------------------------------------------------------------
```

Table 4.3: Unit root test for GR_GDP

```
. xtunitroot llc GR_X1GDP, lag(1)

Levin-Lin-Chu unit-root test for GR_X1GDP
-----------------------------------------
Ho: Panels contain unit roots           Number of panels  =     14
Ha: Panels are stationary               Number of periods =     40

AR parameter: Common                    Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 11.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t        -12.4572
 Adjusted t*          -9.5300       0.0000
------------------------------------------------------------------------------
```

Table 4.4: Unit root test for LTIR

```
. xtunitroot llc X3LTIR, lag(1)

Levin-Lin-Chu unit-root test for X3LTIR
---------------------------------------
Ho: Panels contain unit roots           Number of panels  =     14
Ha: Panels are stationary               Number of periods =     44

AR parameter: Common                    Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 11.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t       -17.1426
 Adjusted t*        -12.3535        0.0000
------------------------------------------------------------------------------
```

Table 4.5: Unit root test for ROA

```
. xtunitroot llc ROA, lag(1)

Levin-Lin-Chu unit-root test for ROA
------------------------------------
Ho: Panels contain unit roots           Number of panels  =     14
Ha: Panels are stationary               Number of periods =     44

AR parameter: Common                    Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 11.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t       -14.3231
 Adjusted t*         -7.6548        0.0000
------------------------------------------------------------------------------
```

Table 4.6: Unit root test for SIZE

```
. xtunitroot llc SIZE, lag(1)

Levin-Lin-Chu unit-root test for SIZE
-------------------------------------
Ho: Panels contain unit roots             Number of panels  =     14
Ha: Panels are stationary                 Number of periods =     44

AR parameter: Common                      Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 11.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t       -14.2021
 Adjusted t*         -9.0179        0.0000
------------------------------------------------------------------------------
```

Table 4.7: Summary of unit root test results

variables	Adjusted t*	p-value	Results
LEV	-11.7673	0.0000	Stationary
GR_GDP	-9.5300	0.0000	Stationary
LTIR	-12.3535	0.0000	Stationary
ROA	-7.6548	0.0000	Stationary
SIZE	-9.0179	0.0000	Stationary

Table 4.2-Table 4.6 are outcomes of applying Levin-Lin-Chu to each subset of data, to examine whether they contain unit roots. Basic specification information is provided in the header of each table. As we use the gaming industry of the United States as the study object with time duration of 11 years quarterly, so each subset of data contains 14 panels and 44 time periods. The null and alternative hypotheses are also presented.

Table 4.7 collects all the results from unit root tests above. As we can see, all of the Levin-Lin-Chu bias-adjusted t statistics (Adjusted t*) are significantly less than zero, and p-values are equal to zero. Therefore, we reject H_0 of a unit root and accept H_1, indicating that all panels are stationary.

4.1.3 Correlation analysis

Before making further estimations, we first test the model's correlativity among variables by using pairwise correlation function.

Table 4.8: Correlation matrix

```
. pwcorr LEV GR_X1GDP X2LTIR ROA SIZE
```

	LEV	GR_X1GDP	X2LTIR	ROA	SIZE
LEV	1.0000				
GR_X1GDP	0.0740	1.0000			
X2LTIR	-0.0024	-0.7107	1.0000		
ROA	-0.2392	0.0469	-0.0258	1.0000	
SIZE	0.4959	0.0609	-0.0528	0.1108	1.0000

Table 4.8 displays all pairwise correlation coefficients. According to the research of Judge et el. (1998), if the absolute value of correlation coefficient is lower than 0.8, then the multicollinearity is low and won't cause much harm. It can be seen that most of absolute values of correlation coefficients in the output are lower than 0.5, which is considered as a moderate correlation level, so we can conclude there is no serious multicollinearity and multiple regression can be performed.

4.1.4 Results of regression modelling

In this subsection, we run Pooled OLS, fixed effects estimation and random effects estimation respectively, and then use Hausman test to decide which one is more appropriate.

Table 4.9: Pooled OLS regression

```
. reg LEV GR_X1GDP X2LTIR ROA SIZE
```

Source	SS	df	MS			
				Number of obs	=	560
				F(4, 555)	=	79.01
Model	18.0849525	4	4.52123813	Prob > F	=	0.0000
Residual	31.7579613	555	.057221552	R-squared	=	0.3628
				Adj R-squared	=	0.3582
Total	49.8429138	559	.089164425	Root MSE	=	.23921

LEV	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
GR_X1GDP	.0047114	.0016338	2.88	0.004	.0015022	.0079207
X2LTIR	.0427633	.0173459	2.47	0.014	.0086916	.076835
ROA	-1.707468	.1961051	-8.71	0.000	-2.092667	-1.322269
SIZE	.0686258	.0042904	16.00	0.000	.0601985	.0770532
_cons	-.0136205	.0576987	-0.24	0.813	-.126955	.099714

Table 4.9 shows the result of Pooled OLS regression analysis, which provides us several pieces of important information. This method is simply a way that sorting out which of those variables has an impact and specifying how high the impact is. In this case, the R^2 value (R-squared) is 0.3628, representing that 36.28% of variability of dependent variable can be explained by independent variables. Then, we can check the F test, in other words, statistical significance (Pro > F) of the regression model. Because the p value of F test is 0.0000, our model applied is proved to be statistically significant. As we are going to find out the relationship between dependent and independent variables, we need to focus on the coefficients (Coef.) for variables and the results of T test. The table shows that GDP growth rate (GR_X1GDP) and firm size (SIZE) are significantly positively correlated with leverage (LEV) at the 1% significance level, long-term interest rate (LTIR) is significantly positively correlated with leverage (LEV) at the 5% significance level, and return on assets (ROA) is significantly negatively correlated with leverage (LEV) at the 1% significance level.

Table 4.10: Fixed effects model

```
. xtreg LEV GR_X1GDP X2LTIR ROA SIZE,fe

Fixed-effects (within) regression               Number of obs     =        560
Group variable: company                         Number of groups  =         14

R-sq:                                           Obs per group:
     within  = 0.0986                                         min =         40
     between = 0.4649                                         avg =       40.0
     overall = 0.3321                                         max =         40

                                                F(4,542)          =      14.82
corr(u_i, Xb)  = -0.1552                        Prob > F          =     0.0000

------------------------------------------------------------------------------
         LEV |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    GR_X1GDP |   .0042542   .0012101     3.52   0.000     .0018772    .0066313
      X2LTIR |   .0430283   .0125555     3.43   0.001     .0183649    .0676917
         ROA |  -.8407724   .1566034    -5.37   0.000    -1.148396   -.5331484
        SIZE |   .0829556   .0198626     4.18   0.000     .0439384    .1219728
       _cons |  -.1084297   .1402257    -0.77   0.440    -.3838821    .1670227
-------------+----------------------------------------------------------------
     sigma_u |  .18355051
     sigma_e |  .17283681
         rho |  .53003482   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(13, 542) = 40.09                    Prob > F = 0.0000
```

The value of Prob > F equals to 0, shows our model is okay. It is a F test to see whether all the coefficients in the model are different than 0. When the result is smaller than 0.05, it means coefficients are different than 0, and the whole model is statistically significant.

In the model presented in table 4.10, GDP growth rate (GR_X1GDP), the long-term interest rate (LTIR) and firm size (SIZE) are significantly positively correlated with leverage (LEV) at the 1% significance level, return on assets (ROA) is significantly negatively correlated with leverage (LEV) at the 1% significance level.

Similarly, we perform the random effects estimation as following table.

Table 4.10: Random effects model

```
. xtreg LEV GR_X1GDP X2LTIR ROA SIZE,re

Random-effects GLS regression                   Number of obs     =        560
Group variable: company                         Number of groups  =         14

R-sq:                                           Obs per group:
     within  = 0.0981                                         min =         40
     between = 0.4747                                         avg =       40.0
     overall = 0.3390                                         max =         40

                                                Wald chi2(4)      =      75.42
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000
```

LEV	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
GR_X1GDP	.0043916	.0011996	3.66	0.000	.0020404	.0067428
X2LTIR	.0426816	.012615	3.38	0.001	.0179566	.0674067
ROA	-.8659008	.1560197	-5.55	0.000	-1.171694	-.5601079
SIZE	.073601	.0129553	5.68	0.000	.0482091	.0989929
_cons	-.0447139	.1031779	-0.43	0.665	-.2469388	.157511
sigma_u	.14521281					
sigma_e	.17283681					
rho	.41379593	(fraction of variance due to u_i)				

Identically with the fixed effects model, the GDP growth rate (GR_X1GDP), long-term interest rate (LTIR) and firm size (SIZE) are significantly positively correlated with leverage (LEV) at the 1% significance level, return on assets (ROA) is significantly negatively correlated with leverage (LEV) at the 1% significance level.

4.1.5 The Hausman test

We eventually implement the Hausman specification test, which compares the fixed-effects model with the random-effects model. To do that, we have stored the results from random effects model and fixed effects model in the previous section to make those results current, and then perform the test.

Table 4.11 The Hausman test

	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
GR_X1GDP	.0042542	.0043916	-.0001373	.0002059
X2LTIR	.0430283	.0426816	.0003467	.0005823
ROA	-.8407724	-.8659008	.0251284	.0216436
SIZE	.0829556	.073601	.0093546	.015208

```
                    b = consistent under Ho and Ha; obtained from xtreg
     B = inconsistent under Ha, efficient under Ho; obtained from xtreg

 Test:  Ho:  difference in coefficients not systematic

               chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                       =        8.37
             Prob>chi2 =      0.0152
```

The null hypothesis here is that difference in coefficients not systematic and the individual-level effects are adequately modeled by a random effects model. Due to the p value of Chi-squared test (Prob > chi2) is 0.0152, we do not reject the null hypothesis, and keep the random effects model as the optimal result.

4.2 Automotive industry

Similar to the previous section, we apply automotive industry data into the modelling process in this part.

4.2.1 Data summary

Table 4.13: Summary of data from automotive industry

```
. xtset Company
       panel variable:  Company (balanced)
```

Table 4.13 (continued)

```
. xtsum LEV GR_X1GDP X2LTIR ROA SIZE
```

Variable		Mean	Std. Dev.	Min	Max	Observations
LEV	overall	.7053572	.1130837	.4532289	1.079495	N = 528
	between		.1021781	.5495921	.9397396	n = 12
	within		.0565636	.4651703	.8451129	T = 44
GR_X1GDP	overall	1.74457	8.813559	-13.80772	10.22775	N = 480
	between		2.32e-16	1.74457	1.74457	n = 12
	within		8.813559	-13.80772	10.22775	T = 40
X2LTIR	overall	2.777652	.8678156	1.563333	4.846667	N = 528
	between		0	2.777652	2.777652	n = 12
	within		.8678156	1.563333	4.846667	T = 44
ROA	overall	.0080313	.0132642	-.0965336	.0759562	N = 528
	between		.0042535	.001701	.0173901	n = 12
	within		.0126224	-.0902033	.0782936	T = 44
SIZE	overall	11.16517	1.33148	8.511368	13.13737	N = 528
	between		1.376877	9.101511	12.77143	n = 12
	within		.178137	10.57502	11.65141	T = 44

The dataset is a strongly balanced panel because in which each panel member is observed every year, therefore the number of observations N equals to panel members n multiply by time period T.

Table 4.13 shows overall mean leverage is 0.7054, verified the conclusion we described in Chapter 2.3 that the overall leverage of automotive industry is high. The panels of macroeconomic variables are the same with which in Table 4.1, so we won't describe it again here. The value of average return on assets is still quite low, however, compared with the negative ROA in gaming industry, automotive industry displays a much better profitability. What's more, average size in gaming industry is around 6 and in automotive industry is 11, shows that the latter industry owns firms with larger scale.

4.2.2 The unit root test

Table 4.14: Unit root test for LEV

```
Levin-Lin-Chu unit-root test for LEV
------------------------------------
Ho: Panels contain unit roots           Number of panels  =     12
Ha: Panels are stationary               Number of periods =     44

AR parameter: Common                    Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 11.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t       -13.5387
 Adjusted t*         -9.0301        0.0000
------------------------------------------------------------------------------
```

Table 4.15: Unit root test for ROA

```
Levin-Lin-Chu unit-root test for ROA
------------------------------------
Ho: Panels contain unit roots           Number of panels  =     12
Ha: Panels are stationary               Number of periods =     44

AR parameter: Common                    Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 11.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t       -14.3646
 Adjusted t*         -9.9206        0.0000
------------------------------------------------------------------------------
```

Table 4.16: Unit root test for SIZE

```
Levin-Lin-Chu unit-root test for SIZE
-------------------------------------
Ho: Panels contain unit roots            Number of panels  =     12
Ha: Panels are stationary                Number of periods =     44

AR parameter: Common                     Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Not included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 11.00 lags average (chosen by LLC)
------------------------------------------------------------------------------
                    Statistic      p-value
------------------------------------------------------------------------------
 Unadjusted t        -13.4148
 Adjusted t*          -8.3289       0.0000
------------------------------------------------------------------------------
```

Table 4.17: Summary of unit root test results

variables	Adjusted t*	p-value	Results
LEV	-9.0301	0.0000	Stationary
GR_GDP	-9.5300	0.0000	Stationary
LTIR	-12.3535	0.0000	Stationary
ROA	-9.9206	0.0000	Stationary
SIZE	-8.3289	0.0000	Stationary

Table 4.17 reports the outputs from all of the unit root tests above. We get the perfect results that each bias adjusted t is smaller than 0 and p-value is equal to 0, so we reject the null hypothesis, concluding that each one of the member panel is stationary.

4.2.3 Correlation analysis

Table 4.18: Correlation matrix

```
. pwcorr LEV L2.GR_X1GDP X2LTIR ROA SIZE

             |      LEV L2.GR_~P   X2LTIR      ROA     SIZE
-------------+---------------------------------------------
         LEV |   1.0000
 L2.GR_X1GDP |  -0.1496   1.0000
      X2LTIR |   0.1297   0.1070   1.0000
         ROA |  -0.2314   0.1572  -0.1109   1.0000
        SIZE |   0.2683   0.0236  -0.0824  -0.0856   1.0000
```

Table 4.18 is simply a table showing correlation coefficients among macroeconomic variables and firm-specific variables in automotive industry. We can see that the pair of LEV and SIZE has the highest correlation of -0.2683. ROA overall has high correlations with other variables, the absolute value of each of them is higher than 0.1. On the whole, all of the correlation coefficients are smaller than 0.5, thus the impact of multicollinearity is considered to be too small that can be ignored.

4.2.4 Results of regression modelling

In this subsection, the methods of Pooled OLS, fixed effects and random effects will be applied in sequence as what we did in Chapter 4.14. As a result, we will get three different models, but only one of them will be kept as the optimal result.

Table 4.19: Pooled OLS regression

```
. reg LEV L2.GR_X1GDP X2LTIR ROA SIZE

      Source |       SS           df       MS      Number of obs   =       456
-------------+----------------------------------   F(4, 451)       =     19.80
       Model |   .8578854         4  .21447135    Prob > F        =    0.0000
    Residual |  4.8842235       451  .010829764   R-squared       =    0.1494
-------------+----------------------------------   Adj R-squared   =    0.1419
       Total |  5.7421089       455  .01262002    Root MSE        =    .10407

------------------------------------------------------------------------------
         LEV |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    GR_X1GDP |
         L2. |  -.0018959   .0005628    -3.37   0.001     -.003002   -.0007898
             |
      X2LTIR |   .0200604   .0059518     3.37   0.001     .0083636    .0317571
         ROA |  -1.179406   .3657229    -3.22   0.001    -1.898139   -.4606736
        SIZE |   .0235369    .003698     6.36   0.000     .0162694    .0308044
       _cons |   .3972708   .0464934     8.54   0.000     .3059002    .4886415
------------------------------------------------------------------------------
```

In the output above, the R^2 value of 0.1494 is quite low, indicating the model explains only little of the variability. In accordance with what we introduced in the methodology part, all individually specific effects are completely ignore by this method, hence the fixed effects model and random effects model are more ideal in this case.

Table 4.20: Fixed effects model

```
. xtreg LEV L2.GR_X1GDP X2LTIR ROA SIZE,fe

Fixed-effects (within) regression               Number of obs     =        456
Group variable: Company                         Number of groups  =         12

R-sq:                                           Obs per group:
     within  = 0.2687                                         min =         38
     between = 0.1112                                         avg =       38.0
     overall = 0.1166                                         max =         38

                                                F(4,440)          =      40.42
corr(u_i, Xb)  = -0.6748                        Prob > F          =     0.0000

------------------------------------------------------------------------------
         LEV |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    GR_X1GDP |
         L2. |  -.0022722   .0002781    -8.17   0.000    -.0028189   -.0017256
             |
      X2LTIR |   .0291986   .0036402     8.02   0.000     .0220443    .0363529
         ROA |  -.9834551   .1784826    -5.51   0.000    -1.334239   -.6326708
        SIZE |   .0902961   .0178855     5.05   0.000     .0551445    .1254476
       _cons |  -.3750202   .2064387    -1.82   0.070    -.7807486    .0307082
-------------+----------------------------------------------------------------
     sigma_u |  .13301451
     sigma_e |  .04873458
         rho |  .88164896   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(11, 440) = 146.95                   Prob > F = 0.0000
```

Table 4.21: Random effects model

```
. xtreg LEV L2.GR_X1GDP X2LTIR ROA SIZE,re

Random-effects GLS regression                   Number of obs     =        456
Group variable: Company                         Number of groups  =         12

R-sq:                                           Obs per group:
     within  = 0.2657                                         min =         38
     between = 0.1121                                         avg =       38.0
     overall = 0.1258                                         max =         38

                                                Wald chi2(4)      =     156.39
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000

------------------------------------------------------------------------------
         LEV |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    GR_X1GDP |
         L2. |   -.002147   .0002738    -7.84   0.000    -.0026837   -.0016103
             |
      X2LTIR |   .0258656   .0033543     7.71   0.000     .0192912      .03244
         ROA |  -.9907795    .179091    -5.53   0.000    -1.341791   -.6397677
        SIZE |   .0649448   .0141665     4.58   0.000      .037179    .0927105
       _cons |   -.082657   .1663948    -0.50   0.619    -.4087848    .2434707
-------------+----------------------------------------------------------------
     sigma_u |   .1047696
     sigma_e |  .04873458
         rho |  .82211597   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

In models presented in Table 4.20 and Table 4.21, all variables have the expected p-value, meaning their correlation with LEV are significant.

4.2.5 The Hausman test

Table 4.22: The Hausman test

```
             ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+----------------------------------------------------------------
     GR_X1GDP |
          L2. |  -.0022722    -.002147       -.0001252        .0000487
      X2LTIR |   .0291986     .0258656         .003333         .001414
         ROA |  -.9834551    -.9907795        .0073244               .
        SIZE |   .0902961     .0649448        .0253513        .0109179
------------------------------------------------------------------------------
                          b = consistent under Ho and Ha; obtained from xtreg
           B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        5.39
                Prob>chi2 =      0.2500
```

Now it comes to the problem that, which model is more ideal? Is it FE or RE? So, we run the Hausman test to find out. As the table presents, p value of Chi-squared test (Prob > chi2) is 0.25, which obviously doesn't equal to 0, so we accept the null hypothesis, and keep the random effects model as the optimal result.

4.3 Discussion

The third part of the chapter is about the empirical findings and discussion of this study.

Table 4.23: Regression results

	Gaming Industry LEV	**Automotive Industry LEV**
GR_GDP	0.0439***	-0.0021*** (lag 2)
	(0.000)	(0.000)
LTIR	0.0427**	0.0259***
	(0.001)	(0.000)

Table 4.23 (continued)

	Gaming Industry LEV	Automotive Industry LEV
ROA	-0.8659***	-0.9908***
	(0.000)	(0.000)
SIZE	0.0736***	0.0649***
	(0.000)	(0.000)
FE/RE	Random Effect	Random Effect

***** Significant at the 1% level. ** Significant at the 5% level. Value in the bracket: p-value.*

According to the empirical study output presented by Table 4.23, we specifically analyze the impact of each variable as follows:

In the U.S. gaming industry, at 1% significance level, there is a significant positive correlation between the GDP growth rate and listed firms' leverage ratios. It shows that after controlling other firm-specific factors, the capital structure reveals a procyclical change. That is, during the expansion phase, with the rises of GDP, the companies' debt ratio increases correspondingly. This finding supports the hypothesis of the trade-off theory.

As for the automotive industry, the variable of GDP growth rate has a negative sign with a lag for two quarters. It appears that during the expansion phase, the capital structure shows a countercyclical change in response to GDP change. This corresponds with the expected conclusions of the pecking order theory, because in the macroeconomic expansion phase, the increase in corporate profits and the increase in net cash flow can bring more endogenous funds to the company to support new projects or repay debts in advance. Therefore, companies will tend to have low target debt ratios, driving companies to issue more shares or fewer bonds to reduce financial leverage. When the macroeconomy declines, the company's net cash flow is reduced, thus it can do nothing but financing from debt, resulting in an increase in financial leverage. The lag shows the response of a company's leverage to GDP change will be delayed for two quarters.

Our results show that there are differences between companies when making decisions on capital structure in respond to the GDP growth. Two industries display totally opposite choices when facing with macroeconomic change. Both of them can be supported by different theories. This might be caused by the differences among industries. The differences could be in the financing preference, financing constraints, or some other possible factors, which need to be examined further.

The regression results show that in both two industries, long-term interest rates are significantly positively correlated with the leverage ratio of listed companies, which gives proof of hypothesis 2 in Chapter 2.5.2. Usually when the interest rate increases, the increase in debt interest will increase the debt financing cost of the company. At this time, a company normally will choose to reduce the debt ratio to ensure that the average capital cost of the company does not rise. However, in the models presented in Table 4.23, it shows an exactly opposite relationship to this. It is because the data we use is U.S. T-bonds rate. The boom in the bond market will directly lead to a downturn in stock market. Therefore, listed companies cannot get sufficient funds from stock market, as a result, companies will increase their leverage.

Same for gaming and automotive industries, the return on assets rate is negatively correlated with the leverage ratio of listed companies at the 1% significance level, which is also in consistent with the expectation based on the pecking order theory. Because companies with strong profitability usually accordingly have strong ability of inner financing, so companies with strong profitability will tend to reduce the debt ratio.

In line with Table 4.23, a company's size has significant positive correlation with its leverage ratio at 1% significance level. The result confirms our hypothesis, concluding that larger firms have higher risk tolerance, hence prefer higher leverage.

In summary, both the trade-off theory and the pecking order theory have a certain explanatory power.

5 Concluding

This thesis is aimed to explore how business cycle would affect the corporate capital structure choice by conducting an investigation of the relationship between leverage and macroeconomic factors. Since macroeconomic conditions have been proved to be important factors that influence corporates' financing choices (e.g. Choe et al.,1993; Korajczyk and Levy, 2003; Cook and Tang, 2010; Xin et al., 2018), this study lays the emphasis on two industries in the United States which are considered to be greatly influenced by the macroeconomy – the gaming industry and the automotive industry. We investigate determinants of listed companies' (get rid of companies with insufficient information) leverage in these two industries with the help of panel data model.

Main content of our thesis can be divided roughly into two major parts, a theoretical one and an empirical one. Chapter 2 and Chapter 3 are contained in theoretical part, and Chapter 4 is the empirical part.

In Chapter 2, we firstly introduce the Modigliani-Miller theorem, the trade-off theory and the pecking order theory, providing the theoretical basis for the whole thesis. In the second section, we describe the general situations of both gaming industry and automotive industry in the United States in detail. Next, we describe the current situation of the targeting market. And then, we refer some prior empirical researches and find out that such industries are highly sensitive to the macroeconomic cycle. Last but not least, we lay our hypotheses in Chapter 2.5 based on the aforementioned theories.

It gives a comprehensive theoretical guidance on the selection and construction of the panel data model in Chapter 3, preparing for the empirical analysis. The theorem of panel data model, and three different estimation methods, as well as several tests are introduced in Chapter 3.1. We set up a model in Chapter 3.2, after that, explain the meaning and measurement approach for each variable in detail. Chapter 3.3 is about the description of sample data. We collect data for the period FQ1 2007-FQ4 2017. By analyzing the dataset, we find that the both industries have high leverage. The automotive industry has even higher leverage level than gaming industry. However, during recent years the difference between two industries' mean leverages tends to diminish to a minimal level.

In Chapter 4, we develop panel data model for each industry, where leverage is treated as the dependent variable. According to the result of Hausman test, we employ the random effects estimator to examine the relationship between the corporate capital structure choice and macroeconomic variable. Our finding that both long-term interest rate and size have significantly positive correlation with leverage ratio and return on assets has obviously negative correlation with leverage ratio is consistent with hypotheses.

The companies' leverage in gaming and automotive industries have totally different reactions regarding to the change of GDP. For companies in the gaming industry, when GDP growth rate increases, the leverage will increase accordingly. This result can support the trade-off theory which holds that when GDP growth accelerate, the macroeconomy is in a boom, an American gaming company will have stronger profitability and lower risk, it can bear higher interest costs than before and benefit more from tax shield, therefore, it will choose to have higher leverage. By contrast, as for automotive industry, the leverage is negatively correlate with GDP growth rate. That is to say, when the GDP growth slows down, an automotive company gains higher profit can get sufficient funds internally, so it will decide to cut down the leverage ratio in two quarters.

We purpose some conjectures and hypotheses about the reasons that might cause such difference. The first one is, some industry-specific factors may exist that influence the financing preference of the whole industry. The second one is, unlike the gaming industry, since automotive companies that listed in American stock markets are mostly the international companies, their financing behavior should also be influenced by the international macroeconomic environment, therefore some bias may be generated. Future research could be focused on these conjectures in order to build more specific models.

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List of Abbreviations

ADF – Augmented Dickey-Fuller

FGLS – Feasible Generalized Least Square

GDP – Gross Domestic Product

GR_GDP – Growth Rate of Gross Domestic Product

LEV – Leverage Ratio

LLC – Levin-Lin-Chu

LM – Lagrange Multiplier

LTIR – Long-term Interest Rate

OLS – Ordinary Least Squares

ROA – Return on Assets

SME – Small and Medium Enterprises

U.S. – United States

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List of Annexes

Annexes

Annex 1: Companies' leverage ratios in the U.S. gaming industry

t	NG	FH	Cant.	Dover	GP	Golden	Empire	Penn	Scient.	Boyd	Melco	WYNN	MGM	LVS
FQ1 2007	0.75	0.42	0.20	0.53	0.33	0.12	1.14	0.79	0.69	0.69	0.14	0.64	0.83	0.71
FQ2 2007	0.78	0.40	0.30	0.53	0.35	0.10	1.17	0.78	0.69	0.69	0.17	0.65	0.82	0.79
FQ3 2007	0.79	0.35	0.20	0.55	0.33	0.14	1.19	0.78	0.69	0.69	0.34	0.63	0.81	0.80
FQ4 2007	0.80	0.40	0.21	0.60	0.29	0.14	1.52	0.77	0.69	0.69	0.33	0.69	0.73	0.80
FQ1 2008	0.77	0.30	0.21	0.58	0.29	0.13	1.64	0.77	0.68	0.71	0.31	0.72	0.78	0.82
FQ2 2008	0.78	0.18	0.31	0.59	0.29	0.14	1.57	0.76	0.69	0.72	0.33	0.74	0.78	0.83
FQ3 2008	0.38	0.19	0.18	0.59	0.26	0.17	1.58	0.74	0.69	0.72	0.41	0.81	0.78	0.85
FQ4 2008	0.35	0.19	0.17	0.58	0.22	0.29	1.66	0.60	0.73	0.75	0.46	0.76	0.83	0.72
FQ1 2009	0.34	0.15	0.18	0.55	0.26	0.28	1.75	0.59	0.75	0.75	0.49	0.75	0.83	0.72
FQ2 2009	0.34	0.16	0.25	0.54	0.29	0.29	1.78	0.59	0.73	0.75	0.51	0.72	0.77	0.74
FQ3 2009	0.23	0.21	0.18	0.55	0.26	0.29	1.53	0.58	0.71	0.75	0.49	0.72	0.80	0.76
FQ4 2009	0.17	0.13	0.14	0.54	0.26	0.29	0.83	0.61	0.73	0.74	0.49	0.58	0.83	0.64
FQ1 2010	0.25	0.09	0.19	0.51	0.22	0.31	0.83	0.59	0.73	0.72	0.48	0.56	0.82	0.63
FQ2 2010	0.26	0.06	0.24	0.51	0.23	0.20	0.86	0.58	0.75	0.72	0.50	0.55	0.86	0.63
FQ3 2010	0.27	0.06	0.20	0.51	0.19	0.21	0.84	0.57	0.74	0.74	0.50	0.55	0.87	0.61
FQ4 2010	0.28	0.06	0.19	0.51	0.34	0.13	0.87	0.60	0.79	0.76	0.48	0.64	0.85	0.60
FQ1 2011	0.38	0.41	0.21	0.48	0.33	0.07	0.87	0.58	0.78	0.75	0.48	0.61	0.84	0.58
FQ2 2011	0.38	0.42	0.27	0.47	0.24	0.11	0.50	0.57	0.77	0.75	0.53	0.61	0.63	0.57
FQ3 2011	0.39	0.44	0.21	0.48	0.22	0.06	0.49	0.56	0.79	0.75	0.52	0.61	0.64	0.56
FQ4 2011	0.38	0.41	0.20	0.48	0.24	0.06	0.50	0.57	0.79	0.77	0.49	0.68	0.64	0.58
FQ1 2012	0.39	0.26	0.23	0.45	0.21	0.06	0.50	0.56	0.78	0.76	0.48	0.94	0.65	0.55
FQ2 2012	0.40	0.17	0.28	0.45	0.21	0.05	0.51	0.55	0.79	0.77	0.48	0.92	0.65	0.55
FQ3 2012	0.40	0.13	0.25	0.45	0.19	0.06	0.49	0.56	0.82	0.78	0.48	0.91	0.67	0.55
FQ4 2012	0.44	0.50	0.23	0.45	0.26	0.06	0.53	0.60	0.83	0.93	0.53	0.99	0.69	0.61
FQ1 2013	0.45	0.49	0.24	0.42	0.19	0.07	0.54	0.58	0.85	0.92	0.51	0.96	0.70	0.60
FQ2 2013	0.44	0.49	0.30	0.42	0.17	0.15	0.85	0.57	0.85	0.91	0.48	0.98	0.69	0.59
FQ3 2013	0.43	0.49	0.26	0.42	0.17	0.12	0.86	0.56	0.84	0.88	0.47	0.97	0.69	0.59
FQ4 2013	0.40	0.50	0.24	0.40	0.14	0.10	1.25	0.65	0.91	0.89	0.44	0.98	0.70	0.58
FQ1 2014	0.42	0.50	0.25	0.37	0.15	0.10	1.36	0.65	0.93	0.89	0.46	0.96	0.69	0.61
FQ2 2014	0.39	0.53	0.31	0.37	0.29	0.11	1.21	0.65	0.95	0.88	0.44	0.97	0.69	0.61
FQ3 2014	0.37	0.54	0.26	0.37	0.33	0.12	1.34	0.68	0.97	0.90	0.51	0.97	0.69	0.60
FQ4 2014	0.37	0.59	0.22	0.38	0.29	0.12	1.43	1.15	1.00	0.90	0.52	0.98	0.71	0.60
FQ1 2015	0.37	0.60	0.25	0.36	0.29	0.12	0.66	0.75	1.02	0.89	0.51	1.02	0.71	0.58
FQ2 2015	0.34	0.61	0.33	0.36	0.34	0.11	0.71	0.74	1.03	0.89	0.52	1.01	0.66	0.61
FQ3 2015	0.31	0.61	0.23	0.35	0.34	0.47	0.86	1.13	1.11	0.89	0.52	1.01	0.65	0.59
FQ4 2015	0.29	0.60	0.27	0.34	0.30	0.44	1.02	1.13	1.19	0.88	0.52	1.00	0.69	0.60

FQ1 2016	0.28	0.59	0.30	0.32	0.28	0.46	0.11	1.13	1.21	0.89	0.54	0.99	0.69	0.61
FQ2 2016	0.27	0.69	0.33	0.31	0.32	0.55	0.15	1.12	1.22	0.88	0.58	1.00	0.64	0.64
FQ3 2016	0.41	0.69	0.26	0.32	0.30	0.51	0.16	1.11	1.24	0.79	0.59	1.01	0.64	0.63
FQ4 2016	0.40	0.68	0.26	0.32	0.28	0.50	0.18	1.11	1.27	0.80	0.59	0.98	0.64	0.63
FQ1 2017	0.38	0.68	0.28	0.29	0.31	0.48	0.64	1.11	1.28	0.79	0.63	0.97	0.64	0.65
FQ2 2017	0.38	0.69	0.35	0.29	0.30	0.48	0.68	1.10	1.28	0.78	0.63	0.97	0.64	0.66
FQ3 2017	0.36	0.69	0.27	0.30	0.26	0.47	0.69	0.95	1.28	0.78	0.63	0.97	0.64	0.65
FQ4 2017	0.35	0.70	0.25	0.29	0.26	0.76	0.67	1.01	1.26	0.77	0.63	0.91	0.60	0.63

Annex 2: Companies' leverage ratios in the U.S. automotive industry

t	Ford	Harley	Volksw.	Daimler	BMW	Toyota	Honda	Nissan	Suzuki	Subaru	Mitsubishi	Mazda
FQ1 2007	1.01	0.48	0.80	0.81	0.76	0.62	0.61	0.70	0.64	0.66	0.83	0.77
FQ2 2007	1.00	0.48	0.80	0.81	0.77	0.61	0.61	0.69	0.63	0.65	0.84	0.76
FQ3 2007	1.00	0.52	0.79	0.73	0.76	0.62	0.61	0.69	0.62	0.63	0.84	0.75
FQ4 2007	0.98	0.58	0.80	0.72	0.76	0.62	0.62	0.69	0.63	0.62	0.83	0.75
FQ1 2008	0.98	0.59	0.77	0.72	0.75	0.62	0.61	0.68	0.61	0.62	0.83	0.75
FQ2 2008	1.01	0.63	0.77	0.72	0.76	0.62	0.61	0.68	0.60	0.62	0.82	0.74
FQ3 2008	1.02	0.65	0.77	0.75	0.77	0.62	0.61	0.68	0.60	0.61	0.80	0.75
FQ4 2008	1.08	0.73	0.78	0.75	0.80	0.61	0.63	0.68	0.63	0.62	0.80	0.72
FQ1 2009	1.08	0.74	0.79	0.76	0.81	0.62	0.63	0.68	0.61	0.62	0.80	0.73
FQ2 2009	1.05	0.74	0.79	0.77	0.81	0.62	0.63	0.68	0.62	0.60	0.80	0.72
FQ3 2009	1.04	0.76	0.79	0.76	0.80	0.62	0.64	0.70	0.63	0.62	0.81	0.73
FQ4 2009	1.04	0.77	0.79	0.75	0.80	0.64	0.65	0.71	0.66	0.66	0.80	0.77
FQ1 2010	1.03	0.80	0.78	0.76	0.81	0.64	0.64	0.70	0.64	0.69	0.81	0.78
FQ2 2010	1.02	0.79	0.79	0.75	0.81	0.63	0.63	0.70	0.63	0.68	0.83	0.78
FQ3 2010	1.01	0.78	0.77	0.74	0.79	0.64	0.62	0.70	0.63	0.69	0.83	0.73
FQ4 2010	1.00	0.77	0.76	0.72	0.78	0.64	0.62	0.70	0.54	0.69	0.81	0.74
FQ1 2011	0.99	0.75	0.76	0.71	0.77	0.64	0.61	0.69	0.54	0.68	0.83	0.73
FQ2 2011	0.97	0.73	0.74	0.72	0.76	0.63	0.60	0.69	0.53	0.66	0.82	0.73
FQ3 2011	0.96	0.73	0.74	0.72	0.78	0.63	0.60	0.69	0.52	0.64	0.82	0.73
FQ4 2011	0.92	0.75	0.75	0.72	0.78	0.63	0.60	0.70	0.50	0.65	0.81	0.76
FQ1 2012	0.91	0.73	0.75	0.72	0.77	0.63	0.59	0.68	0.50	0.65	0.81	0.77
FQ2 2012	0.91	0.71	0.76	0.74	0.78	0.63	0.60	0.69	0.52	0.66	0.81	0.78
FQ3 2012	0.90	0.73	0.75	0.74	0.78	0.63	0.60	0.69	0.52	0.66	0.81	0.81
FQ4 2012	0.91	0.72	0.74	0.76	0.77	0.64	0.62	0.69	0.52	0.67	0.80	0.75
FQ1 2013	0.91	0.72	0.74	0.76	0.76	0.63	0.60	0.69	0.52	0.66	0.79	0.74
FQ2 2013	0.90	0.71	0.74	0.76	0.76	0.63	0.60	0.69	0.51	0.66	0.78	0.73
FQ3 2013	0.90	0.70	0.73	0.75	0.75	0.63	0.61	0.70	0.50	0.65	0.77	0.74
FQ4 2013	0.87	0.68	0.72	0.74	0.74	0.64	0.62	0.68	0.48	0.62	0.76	0.74
FQ1 2014	0.87	0.68	0.74	0.75	0.74	0.64	0.61	0.68	0.47	0.60	0.74	0.73
FQ2 2014	0.87	0.67	0.73	0.76	0.75	0.63	0.61	0.67	0.48	0.59	0.72	0.72
FQ3 2014	0.87	0.67	0.74	0.76	0.75	0.63	0.62	0.69	0.47	0.57	0.70	0.70
FQ4 2014	0.88	0.69	0.74	0.76	0.76	0.63	0.61	0.68	0.48	0.59	0.64	0.70
FQ1 2015	0.88	0.71	0.76	0.78	0.78	0.63	0.60	0.68	0.46	0.57	0.63	0.68
FQ2 2015	0.88	0.71	0.74	0.76	0.77	0.63	0.60	0.68	0.47	0.56	0.61	0.67
FQ3 2015	0.88	0.76	0.75	0.76	0.75	0.63	0.61	0.69	0.45	0.53	0.60	0.65
FQ4 2015	0.87	0.82	0.77	0.75	0.75	0.63	0.61	0.69	0.48	0.53	0.58	0.64
FQ1 2016	0.88	0.82	0.77	0.76	0.74	0.63	0.60	0.69	0.45	0.51	0.55	0.63
FQ2 2016	0.87	0.80	0.78	0.77	0.76	0.62	0.60	0.69	0.53	0.50	0.51	0.61

FQ3 2016	0.87	0.80	0.78	0.77	0.75	0.62	0.60	0.70	0.55	0.47	0.52	0.61
FQ4 2016	0.88	0.81	0.77	0.76	0.75	0.62	0.61	0.70	0.56	0.48	0.52	0.62
FQ1 2017	0.87	0.81	0.74	0.76	0.74	0.61	0.61	0.70	0.58	0.47	0.59	0.60
FQ2 2017	0.87	0.80	0.75	0.75	0.73	0.60	0.60	0.71	0.58	0.47	0.64	0.59
FQ3 2017	0.87	0.82	0.75	0.75	0.72	0.62	0.60	0.73	0.55	0.47	0.56	0.60
FQ4 2017	0.86	0.82	0.74	0.74	0.72	0.62	0.60	0.72	0.55	0.47	0.53	0.58

Annex 3: Macroeconomic data

t	GDP	CPI
FQ1 2007	15493.328	86.2035
FQ2 2007	15582.085	87.1798
FQ3 2007	15666.738	87.7317
FQ4 2007	15761.967	88.8078
FQ1 2008	15671.383	89.7698
FQ2 2008	15752.308	90.9376
FQ3 2008	15667.032	92.3398
FQ4 2008	15328.027	90.2250
FQ1 2009	15155.940	89.6044
FQ2 2009	15134.117	90.0809
FQ3 2009	15189.222	90.8559
FQ4 2009	15356.058	91.5673
FQ1 2010	15415.145	91.7124
FQ2 2010	15557.277	91.6801
FQ3 2010	15671.967	91.9488
FQ4 2010	15750.625	92.6934
FQ1 2011	15712.754	93.6826
FQ2 2011	15825.096	94.7478
FQ3 2011	15820.700	95.3656
FQ4 2011	16004.107	95.7937
FQ1 2012	16129.418	96.3332
FQ2 2012	16198.807	96.5365
FQ3 2012	16220.667	96.9724
FQ4 2012	16239.138	97.6172
FQ1 2013	16382.964	98.0096
FQ2 2013	16403.180	97.9023
FQ3 2013	16531.685	98.4318
FQ4 2013	16663.649	98.7957
FQ1 2014	16621.696	99.4057
FQ2 2014	16830.111	99.9250
FQ3 2014	17033.572	100.1863
FQ4 2014	17113.945	99.9589
FQ1 2015	17254.744	99.2989
FQ2 2015	17397.029	99.9556
FQ3 2015	17438.802	100.3372
FQ4 2015	17456.225	100.3673
FQ1 2016	17523.374	100.3506
FQ2 2016	17622.486	101.0274

FQ3 2016	17706.705	101.4898
FQ4 2016	17784.185	102.1772
FQ1 2017	17863.023	102.9247
FQ2 2017	17995.150	102.9504
FQ3 2017	18120.843	103.4933
FQ4 2017	18223.758	104.3391